

A Comparison of In-Situ Observations
with Meso-Scale Forecasts

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Objective: The objective of this project is to investigate the ability of meso-scale models to forecast observed phenomena confined to the boundary layer. Specifically, to determine the skill of MM5 in forecasting strong low level inversions and associated increased wind speeds.

Background: From 06 to 08 August 2001, surface winds approximately 30nm off the Central Coast of California were observed in excess of 30kts. Rawinsonde data showed a sharp inversion at ~500m (~950mb) and rapid decrease in wind speed with height.

Comparison: MM5 Analyses and 36, 24 & 12 hour forecasts (taus) were compared with 4 sondes that were launched closest to synoptic hours. MM5 fields of interest were Mean Sea Level Pressure (MSLP), 980mb, 840mb, vertical profiles, and vertical cross sections.

Discussion: The MSLP fields were used to determine the synoptic picture and showed high pressure dominating throughout the entire Pacific Northwest.

980mb ([fig 1](#)) fields consistently and accurately forecast winds from the northwest. The wind speed forecasts, however, were frequently mishandled. That is, although MM5 correctly identified a wind speed increase at the 980mb level, the forecast weakened the maximum predicted winds through the forecast series from 36hrs through the analyses. The result was that the forecast wind speeds at 36hrs were more representative of observed conditions than the analyses.

At 840mb ([fig 2](#)) MM5 handled both the wind speed and direction well. The high pressure dominating the region was forecast well by all taus.

Vertical profiles ([fig 3](#)) adequately predicted the height and magnitude of the temperature inversion. As expected from the 980mb performance, the profiles were more accurate with wind direction than speed. Furthermore, there were several profiles that did not extend to the surface. This is due to the resolution of the terrain database. The lack of data down to the surface can prevent identification of lower level features (ie high wind speed forecasts). The vertical profiles should, as with all forecasting aids, be used in conjunction with other forecasting tools.

The only vertical cross section ([fig 4](#) & [fig 5](#)) used in this study was the one extending from 35.6N 121.2W to 35.4N 122.8W. This section intersects the coast at about a 45 degree angle and it is almost perpendicular to the 980mb wind direction for 07/00Z. This section is therefore good for comparison with balloon #4 ([fig 6](#)) which was launched at 07/01Z within a few miles of the section. The cross section is an excellent representation of both the vertical and horizontal wind structure predicted by the model. As the section gives complete coverage down to the surface, it is a useful tool to see below the 980mb level (the MSLP fields covered too broad of an area to adequately interpret forecast wind speeds). The advantage of the vertical cross section over vertical profiles is that one can visually extrapolate wind structure into areas where the terrain database prevents coverage.

Conclusions:

- MM5 was able to identify the low level inversion.
- The model correctly forecast the wind direction with height.
- Although increases in surface winds were forecast, the model was off by as much as 10kts at times. Longer wind speed forecasts (36 & 24hr) were more accurate than shorter ones (24hr and Analysis).
- Vertical cross-sections are easier to interpret than vertical soundings.
- The excellent performance of this, or any, model should not replace the value added by the forecaster. Specifically, the under-forecast of the model with respect to surface wind speeds could be compensated for by a forecaster.